



Langley Research Center

LAPG 1710.42

Effective Date: August 11, 2000

Expiration Date: August 11, 2005

**SAFETY PROGRAM FOR MAINTENANCE OF
GROUND-BASED PRESSURE VESSELS
AND PRESSURIZED SYSTEMS**

National Aeronautics and Space Administration

RESPONSIBLE OFFICE: OFFICE OF SAFETY AND MISSION ASSURANCE

LAPG 1710.42

PREFACE

All ground based pressure vessels, pressurized components, and pressurized systems shall be designed, fabricated, installed, operated, periodically inspected, maintained, repaired, and certified/recertified in accordance with applicable codes, standards, guides, and Federal regulations. This Langley Research Center (LaRC) Procedures and Guidelines (LAPG) details the LaRC program for maintaining pressure system safety.

Authority for this LAPG is NASA Policy Directive (NPD) 8710.5, "NASA Safety Policy for Pressure Vessels and Pressurized Systems."

Comments, suggestions, or proposed changes to this LAPG should be addressed to the Office of Safety and Mission Assurance (OSMA).

Delma C. Freeman
Deputy Director

DISTRIBUTION:

SDL 040, SDL 043, SDL 410, SDL 411, and SDL 412
429/Office of Safety and Facility Assurance (OSFA), Office of Safety and Mission Assurance (OSMA) (100 copies)

TABLE OF CONTENTS

Chapter	Page
1. INTRODUCTION.....	1-1
1.1. PURPOSE	1-1
1.2. APPLICABILITY	1-1
1.3. ORGANIZATIONAL RESPONSIBILITIES	1-1
1.3.1. Executive Safety Board (ESB)	1-1
1.3.2. Pressure Systems Committee (PSC)	1-3
1.3.3. Pressure Systems Manager (PSM)	1-4
1.3.4. Field Engineering Support Services (FESS) Contractor COTR.....	1-4
1.3.5. Facility Safety Head (FSH)	1-5
1.3.6. Facility Coordinator (FC)	1-5
1.3.7. Recertification and Configuration Management (R&CM) Contractor COTR	1-6
1.3.8. Standard Practice Engineer (SPE)	1-6
1.3.9. Facility Systems Project Manager (PM)	1-6
1.3.10. Systems Engineering Competency (SEC)	1-7
1.3.11. Construction Inspection Contractor	1-7
2. RECERT PROGRAM.....	2-1
2.1. GENERAL	2-1
2.2. METHODOLOGY	2-1
2.3. PRIORITY INSPECTION LIST	2-3
2.4. RECERT PHASE 1.....	2-3
2.4.1. New Systems	2-3
2.4.2. Existing Systems	2-3
2.4.3. Field Survey	2-6
2.4.4. Evaluation of Pressure Vessel or System	2-6
2.4.5. Nondestructive Examination	2-8
2.4.6. Pressure Vessel Analysis	2-9
2.4.7. Piping Analysis	2-12
2.5. RECERT PHASE 2.....	2-12
2.5.1. New Systems	2-12
2.5.2. Existing Systems	2-12
2.5.3. Repair/Replace Defective Components.....	2-13
2.5.4. Inservice Inspection Plan/Schedule/Requirements	2-13
2.5.5. Documentation for Pressure Vessels/Systems - Permanent Record File	2-14

2.6. RECERT PHASE 3 – INSERVICE INSPECTION	2-19
2.6.1. Performing Inservice Inspection	2-19
2.6.2. Results of Inservice Inspection/Repairs.....	2-20
2.6.3. Updating Pressure System Documents (PSD).....	2-20
2.6.4. Periodic Review of Permanent Record File.....	2-20
2.7. ANNUAL REPORTS	2-21
2.8. PRESSURE SYSTEMS DATABASE	2-21
3. MAINTENANCE AND REPAIR PROGRAM.....	3-1
3.1. GENERAL	3-1
3.2. PREVENTIVE MAINTENANCE (PM)	3-1
3.3. REPAIRS.....	3-1
3.4. PLANNED SYSTEM MODIFICATIONS	3-1
3.5. INTERFACE WITH PRESSURE SYSTEM DATABASE	3-2
4. OPERATIONS.....	4-1
4.1. GENERAL	4-1
4.2. OPERATING PROCEDURES/CHECKLISTS	4-1
4.3. OPERATIONAL RECORDS/LOGS.....	4-1
4.4. ACCIDENTS/INCIDENTS.....	4-1
5. TRAINING	5-1
5.1. GENERAL	5-1
5.2. HIGH-PRESSURE SYSTEM AWARENESS TRAINING	5-1
5.3. HIGH-PRESSURE SYSTEM OPERATOR TRAINING	5-2
5.4. INSPECTOR TRAINING	5-2

APPENDICES

Appendix	Page
A. TAGGING OF PRESSURE VESSELS, RELIEF VALVES, AND FLEXIBLE HOSES	A-1
B. WAIVERS/DEVIATIONS.....	B-1
C. VISUAL INSPECTION OF PRESSURE SYSTEMS.....	C-1
D. ACRONYMS	D-1
E. DEFINITIONS.....	E-1
F. REFERENCES	F-1

LIST OF FIGURES

	Page
FIGURE 1-1, THE FIVE ELEMENTS OF LANGLEY'S PRESSURE VESSEL/SYSTEM SAFETY PROGRAM	1-2
FIGURE 2-1, RECERT PROCESS	2-2
FIGURE 2-2, KEY TO RECERTIFICATION STATUS SHEETS (COMPONENT INVENTORY)	2-4
FIGURE 2-3, RECERTIFICATION STATUS SHEET (EXAMPLE)	2-5
FIGURE 2-4, DOCUMENT REFERENCE SHEET	2-8
FIGURE 2-5, RECERTIFICATION LETTER (EXAMPLE).	2-15

LIST OF TABLES

	Page
TABLE 1-1, SYSTEMS EXCLUDED FROM RECERTIFICATION PROGRAM	1-3
TABLE 2-1, BRIEF DESCRIPTION OF EACH RECERT PHASE.....	2-1
TABLE 2-2, TYPICAL DATA PROBLEM WITH POSSIBLE SOLUTIONS.....	2-7
TABLE 2-3a, NONDESTRUCTIVE EXAMINATION PERFORMED DURING SYSTEM RECERTIFICATION: CODE-STAMPED VESSELS.....	2-10
TABLE 2-3b, NONDESTRUCTIVE EXAMINATION PERFORMED DURING SYSTEM RECERTIFICATION: NON-CODE-STAMPED VESSELS, SECTION VIII, DIVISION 1 ANALYSIS.....	2-10
TABLE 2-3c, NONDESTRUCTIVE EXAMINATION PERFORMED DURING SYSTEM RECERTIFICATION: NON-CODE-STAMPED VESSELS, SECTION VIII, DIVISION 2 ANALYSIS	2-11
TABLE 2-3d, NONDESTRUCTIVE EXAMINATION PERFORMED DURING SYSTEM RECERTIFICATION: ALL PIPING EXCEPT INSULATED STEAM PIPING.....	2-11
TABLE 2-3e, NONDESTRUCTIVE EXAMINATION PERFORMED DURING SYSTEM RECERTIFICATION: INSULATED STEAM PIPING	2-12
TABLE 2.4, REQUIRED DOCUMENTATION IN THE PERMANENT RECORD FILE	2-16

1. INTRODUCTION

1.1. PURPOSE

The purpose of this LAPG is to provide instructions for the elements of the safety program for maintaining ground-based pressure vessels and systems at LaRC. This pressure system safety program consists of five elements: documentation, inservice inspection, maintenance & repair, operation, and training, as depicted in Figure 1-1. The first three of these elements: documentation, inservice inspection, and maintenance & repair make up the Pressure Systems Recertification (RECERT) Program here at LaRC. This document provides detailed instructions for the RECERT program by:

1. Delineating the RECERT Program by outlining the process for recertifying ground-based pressure vessels and systems at LaRC and
2. Delineating organizations and individuals, including their responsibilities, who are responsible for recertifying ground-based pressure vessels and systems at LaRC.

1.2. APPLICABILITY

Pressure vessels and systems that shall be included in the RECERT Program are detailed in NPG 1700.6A, "Guide for Inservice Inspection of Ground-Based Pressure Vessels and Systems." In general, any vessel or system that has an operating pressure at or above 150 psi shall be included. Vacuum systems shall be included to ensure the vessel and/or piping can withstand the external pressure. Systems with pressures below 150 psi shall be entered in the program based on the type of media (hazardous) or the potential risk if a failure occurs. These systems shall be designated by the Pressure Systems Manager (PSM) along with the Pressure Systems Committee (PSC). A complete listing of all systems in the recertification program and their status shall be maintained by the PSM.

In accordance with NPG 1700.6A, "Guide for Inservice Inspection of Ground-Based Pressure Vessels and Systems," the items identified in Table 1-1 may be excluded from the RECERT Program. These items are excluded because inservice inspection for these systems is covered by a national consensus standard or they do not present sufficient hazard to require other than normal routine maintenance.

1.3. ORGANIZATIONAL RESPONSIBILITIES

1.3.1. Executive Safety Board (ESB)

The Executive Safety Board (ESB) shall:

- Review and approve/disapprove written deviation requests that have been recommended for approval by the Pressure Systems Committee (PSC).

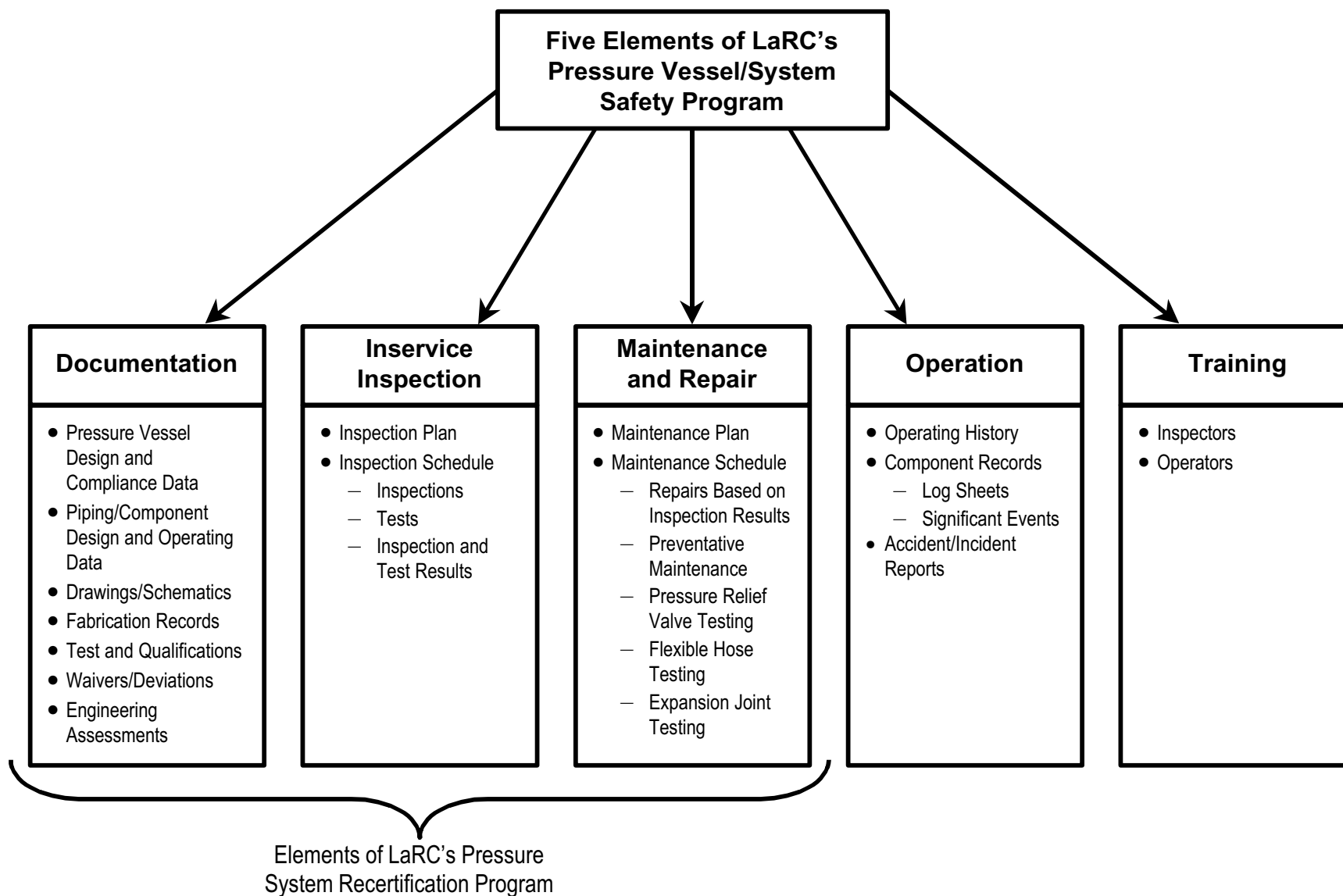


Figure 1-1, The Five Elements of Langley's Pressure Vessel/System Safety Program.

Table 1-1, Systems Excluded from Recertification Program.

Item	Justification for Exclusion
Fire Extinguishers	Fire extinguishers shall be covered by the Code of Federal Regulations Title 29 - Labor (CFR 29), Chapter XVII- OSHA Part 1910, Subpart L.
Heating Boilers	Heating boilers shall be covered by ASME Boiler and Pressure Code, Section VI.
Power Boilers	Power boilers shall be covered by ASME Boiler and Pressure Code, Section VII.
Air-Pak Rescue Equipment or Other Self-Sustaining Breathing Apparatus	Air-pak rescue equipment and other self-sustaining breathing apparatus shall be covered by 29 CFR Labor, Chapter XVII - OSHA part 1910, Subpart I, Sections 1910.134 - 1910.140.
Mobile Equipment for Gases and Liquids	Mobile equipment for gases and liquids shall be covered by Department of Transportation (DOT) Regulations 49 CFR.
Heating, Ventilation, Air Conditioning, and Refrigeration Systems	Heating, ventilation, air conditioning, and refrigeration systems shall be covered by manufacturer installation, operation, and maintenance instructions.
Utilities	Many pressure vessels and systems in use at LaRC fall into a utility category and present minimum potential hazard. Typically, pressure vessels/systems (e.g., water heaters, space heaters, or similar general utility services) that meet the guidelines established in NPG 1700.6A "Guide for Inservice Inspection of Ground-Based Pressure Vessels and Systems," shall be excluded from the certification and recertification program.
Other Energy Systems	Other low energy, low risk systems shall be submitted to the PSM for review and consideration.

1.3.2. Pressure Systems Committee (PSC)

The members of the Pressure Systems Committee (PSC) shall include the appointed chairperson of the committee, the Standard Practice Engineer (SPE), the PSM, a representative from the Office of Safety and Facility Assurance (OSFA), the Cryogenic Systems Consultant, and other technical experts appointed by the chairperson. The Office of Safety and Mission Assurance (OSMA) shall maintain the current membership list for the committee. The PSC shall:

- Recommend requirements, standards, and procedures for systems designed to use, confine, or distribute pressurized media.
- Review written deviation requests and recommend approval to the ESB or return deviation to design organization for redesign.

1.3.3. Pressure Systems Manager (PSM)

The Pressure Systems Manager (PSM) shall be designated in writing by the Center Director. The PSM shall:

- Serve as a member of the PSC.
- Ensure that all LaRC pressure vessels/systems are recertified in compliance with applicable codes, standards, and guidelines.
- Act as the technical and managerial authority for the LaRC RECERT program.
- Ensure that necessary documentation to support the recertification program is received for all pressure vessels/systems.
- Control the retention of all pressure vessel/system certification/recertification documents as part of the permanent record file for the specific system.
- Assign pressure vessels/systems to the Recertification and Configuration Management (R&CM) contractor for field surveys and non-destructive examination (NDE).
- Ensure that Pressure Systems Documents (PSDs) are prepared for all existing pressure vessels/systems at LaRC.
- Submit proposed deviations to the PSC when appropriate.
- Approve disposition (e.g., derate, repair, scrap) of all pressure vessels/systems which do not meet the requirements of this LAPG.
- Prepare and forward a NASA RECERT Status Report annually. This report shall be sent to NASA Headquarters with a courteous copy sent to the OSFA.
- Maintain baseline inventory/status of all pressure vessels/systems and prepare a yearly summary report for NASA Headquarters, which shall be included with NASA RECERT Status Report above. The status shall indicate current pressure vessel/system PHASE (1, 2, or 3). The summary report shall indicate anticipated inspection/repair time frames for all PHASE 1 or 2 systems.
- Act as the primary pressure system advisor for the LaRC PSC.
- Review/approve all field survey or Inservice Inspection Plan (IIP) procedures for all inservice pressure systems.
- Establish periodic maintenance checks regarding pressure vessels, piping components, relief valves, flexible hoses, expansion joints, and other components as required. These checks shall be listed in the IIP schedule.
- Provide guidance to Project Managers (PMs) in the initial certification of pressure vessels and systems.
- Ensure appropriate permanent record file is forwarded to another installation if any pressure vessel/system is transferred from one installation to another, either by physical movement or through transfer of responsibility to a non-LaRC agency. Ensure that appropriate waivers and deviations are included in the permanent record file.

1.3.4. Field Engineering Support Services (FESS) Contractor COTR

The Field Engineering Support Services (FESS) Contracting Officers Technical

Representative (COTR) shall ensure the FESS Contractor:

- Performs a periodic maintenance check in accordance with the Computerized Maintenance Management System (CMMS).
- Tags relief valves and flexible hoses, as required at installation and during preventative maintenance checks. See appendix A for further guidance.
- Maintains individual logs of relief valves tested. The logs shall depict date tested, valve number, pressure setpoint, and adjustments or repairs made to the relief valves.
- Submits completed maintenance data sheets to the applicable Facility Coordinator (FC) including, as necessary, any historical data sheets to indicate adjustments or repairs completed to components.

1.3.5. Facility Safety Head (FSH)

Every facility at LaRC has a Facility Safety Head (FSH) who is nominated by the line organization and approved by the Vice-Chairperson of the ESB. The FSH shall:

- Review computer maintenance entries to ensure that pressure vessel/system repairs have been documented.
- Review inservice inspection sheets with Recertification and Configuration Management (R&CM) contractor to coordinate non-destructive evaluation (NDE) as required.
- Ensure that personnel training and facility operational knowledge of procedures for working with pressure vessels and systems is current. Qualified operators shall be certified in writing.
- Coordinate pressure systems training as required. General pressure system safety training shall be conducted after system modifications and after any extended “down” period.
- Maintain pressure vessel/system training records for personnel assigned to the facility.
- Review operational procedures and ensure that changes, modifications, or alterations are appropriately reflected.
- Maintain current log of operations.

1.3.6. Facility Coordinator (FC)

Every facility at LaRC has a Facility Coordinator (FC) who is appointed by the line organization and FSH. The FC shall:

- Initiate maintenance requests for repairs and/or facility modifications.
- Submit work requests as required.
- Review and submit to the Systems Engineering Competency (SEC) all computerized maintenance sheets, whether performed by the FESS contractor or in house maintenance personnel.
- Coordinate with PSM and R&CM Contractor for walk-through of pressure vessels/systems to verify/update Pressure Systems Documents (PSDs).

1.3.7. Recertification and Configuration Management (R&CM) Contractor COTR

The Recertification and Configuration Management (R&CM) COTR shall ensure the R&CM contractor:

- Performs detailed field surveys.
- Prepares the Recertification Status Sheets for pressure system components.
- Performs non-destructive evaluation (NDE) on existing pressure systems as part of the RECERT program.
- Performs engineering analyses and provide PSM with recommendations to be taken regarding specific pressure system components.
- Prepares the initial CAD isometric drawings for the Pressure Systems Documents (PSD).
- Prepares the initial PSD and maintains them as Configuration Controlled Documents.
- Prepares the Inservice Inspection Plan/Schedule/Requirements.
- Gathers documentation for the Permanent Record File for assigned pressure vessels and systems.
- Maintains permanent RECERT files including NDE results.
- Performs inspections as required by IIP.
- When directed, repairs major deficiencies discovered during non-destructive examinations and analyses.
- Participates in the formulation of the annual pressure systems priority inspection list.
- Obtains and maintains documentation for the permanent system record files. Specific contents of the permanent record files are denoted in Chapter 2.
- Notifies PSM if IIP schedule cannot be met.

1.3.8. Standard Practice Engineer (SPE)

The Standard Practice Engineer (SPE) shall:

- Serve as a member of the PSC.
- Evaluate and approve all designs and modifications to previously certified/recertified pressure vessels/systems.
- During normal system repairs, certify compliance with applicable codes, standards, guides and LaRC supplements.
- Ensure referral to the PSC when a system does not comply with applicable codes.
- Grant waivers of hydrostatic testing if necessary. See Appendix B of this document for details on waivers and deviations.

1.3.9. Facility Systems Project Manager (PM)

The Facility Systems Project Manager (PM) shall:

- Initiate a Change Notification Sheet (CNS) covering each specific pressure

system project.

- Ensure that an inspector is assigned to inspect all new pressure piping and associated equipment and all alterations, repairs, modifications, and additions to pressure vessels and pressure piping.
- Ensure compliance with standards, codes and regulations regarding pressure vessels/systems or ensure that deviations have been approved by the PSC.
- Provide specifications, drawings, purchase requests, and inservice inspection and recertification requirements.
- Provide written certification that the pressure system installation was performed in accordance with all documentation as defined in LAPG 1710.40, "Safety Regulations Covering Pressurized Systems."
- Ensure that documentation (see Chapter 2 for types of documentation) regarding the components used in the modification, alteration, or construction of pressure systems are retained. This information shall be required by contract specifications to be submitted by the contractor during the initial construction or modification of a pressure system. This documentation shall become a major part of the permanent record file. The PM shall turn over documentation collected during the initial construction or modification to the PSM after the completion of Operational Readiness Review (ORR) or Systems Operations Committee (SOC).
- Obtain guidance from the PSM, regarding pressure vessel/system documentation, inservice inspection, and recertification plan.

1.3.10. Systems Engineering Competency (SEC)

The Systems Engineering Competency (SEC) shall:

- Maintain the CMMS program/data
- Enter data from the maintenance input data sheets completed by either the FC or the FESS contractor.
- Enter and retain historical maintenance information that has been submitted regarding a particular facility.
- Maintain the database for all computerized preventative maintenance at LaRC.
- Approve all radiography taken of existing pressure vessels/systems at LaRC.

1.3.11. Construction Inspection Contractor

The Construction Inspection (CI) Contractor COTR shall ensure the CI Contractor works with the PM and Construction Management Team and ensure the CI Contractor.

- Checks to ensure that all installation inspections of new pressure systems and vessels meet the applicable portion of the specifications.
- Witnesses all tests (hydrostatic, pneumatic and operational) as specified by the designer.
- Coordinates with PM to resolve any problems with interpretation of specs.
- Verifies that test apparatus is in calibration before use.

2. RECERT PROGRAM

2.1. GENERAL

The primary focus of the LaRC Pressure Systems Recertification (RECERT) program is to examine existing pressure vessels and systems to ensure their structural integrity and minimize the potential for mishaps. This shall be accomplished via inspection, documentation, non-destructive evaluation (NDE), repairs, and engineering assessment. The LaRC RECERT program is based on requirements defined within NPD 8710.5, "NASA Safety Policy for Pressure Vessels and Pressurized Systems" and NPG 1700.6A, "Guide for Inservice Inspection of Ground-Based Pressure Vessels and Systems." Specific products of the RECERT program shall consist of:

- The Pressure Systems Document (PSD),
- The Inservice Inspection Plan (IIP), and
- The Recertification Letter.

2.2. METHODOLOGY

LaRC's RECERT program must account for the fact that LaRC has numerous existing systems that require recertification and new systems that do not require recertification but must be incorporated into the RECERT program. As depicted in Figure 2-1, each pressure vessel/system goes through three RECERT phases. A brief description of each phase and what shall be accomplished for an existing or new system is provided in Table 2-1.

Table 2-1, Brief Description of Each RECERT Phase.

Phase	Existing System	New System
1	R&CM COTR ensures the R&CM Contractor gathers/develops documentation and performs field survey, initial NDE, and engineering analysis of the pressure vessel or system.	PM shall gather documentation for permanent record file and provide it to the PSM.
2	Additional actions (such as repairs, modifications, or more extensive NDE) that are required to recertify the system shall be performed. Additionally, the pressure systems documentation and permanent record file is completed.	The R&CM COTR shall ensure the R&CM Contractor prepares the permanent record file. If not provided by PM, the R&CM COTR ensures the R&CM Contractor prepares the IIP.
3	The R&CM COTR ensures the R&CM Contractor performs periodic inspections in accordance with the IIP.	The R&CM COTR ensures the R&CM Contractor performs periodic inspections in accordance with the IIP.

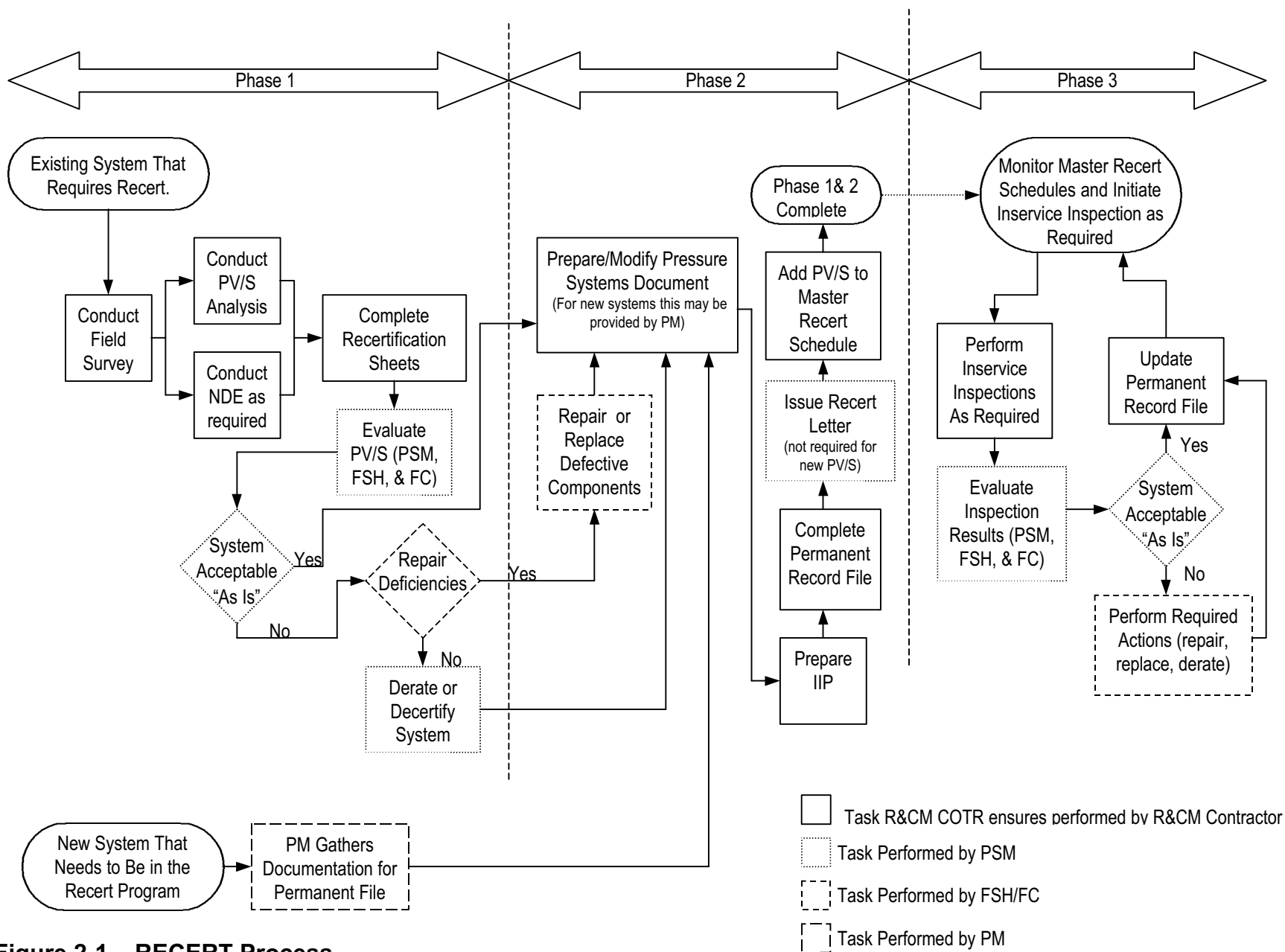


Figure 2-1, RECERT Process.

2.3. PRIORITY INSPECTION LIST

As part of the RECERT program the PSM shall determine the priority of recertifying particular pressure systems and vessels. Using risk assessment techniques, the PSM shall prioritize pressure vessels and systems that have not been entered into the RECERT program. Elements that are used in prioritizing the inspection list shall include energy considerations (amount and type of agent under pressure), cyclic duty, environmental considerations (susceptibility to erosion/corrosion), number and proximity of personnel, cost of replacement, schedule impact, and age. In determining the priority list, a combination of likelihood of a failure along with the consequence of a failure shall be used to formulate the total risk. The PSM shall review and update the priority inspection list at least annually.

2.4. RECERT PHASE 1

The activities that shall be performed during phase 1 depend on whether the system is an existing system or a new/modified system. This section details the activities that shall be performed during phase 1.

2.4.1. New Systems

For new pressure vessels and systems, after the Operational Readiness Review (ORR) or Systems Operations Committee (SOC) review, the Facility Systems Project Manager (PM) shall send to the PSM all documentation required for the establishment of the pressure system database and permanent record file. See section 2.5.5 for a detailed description of the data/documentation required.

It shall be the responsibility of the PM to either develop the required documentation or incorporate the development of the documentation into the appropriate contract specification. For those cases where the appropriate documentation is not available, the PM shall inform the PSM. The PM and PSM shall work together to have the appropriate actions taken (i.e., field surveys, perform NDE, or perform pressure vessel/system analysis) to develop the necessary documentation.

2.4.2. Existing Systems

For an existing system, the first phase of the RECERT program shall consist of gathering and evaluating the information regarding a specific pressure vessel or system. Additionally, during the first phase of RECERT, the establishment of the pressure system database and permanent record file shall be initiated. The primary results of phase 1 shall be recommendations of action(s) that shall be taken with respect to specific system components. These recommendations shall include decertifying (removal from service), recertifying (either to original or changed operational parameters), conducting repairs, or additional tests necessary to recertify the pressure vessel/system. As depicted in Figure 2-1, there shall be several items completed in phase 1 of the RECERT program: perform field surveys, perform NDE, and perform pressure vessel/system analysis.

UPPER LEFT: Facility Name and Building Number. System Name. Reference Sketch for Recertification Status Sheet. Date of latest computer printout. Page Number.

UPPER RIGHT: System Designation.

Fifteen Columns - Read Left to Right

- (1) NO: Component number which can be found on the sketch referred to in the upper right of the recertification status sheet. (Example: REF SK. 60-A-1)
- (2) COMPONENT: Component name. The names are derived from ANSI and SAE.
- (3) END: End connection. It is listed by abbreviation: TH = threaded; SW = socket weld; BW = butt weld; FL = flanged; CW = connection weld; SO = slip on (flange only); WN = weld neck (flange only).
- (4) MANUFACTURER/DESCRIPTION: Consists of the information which shall be gathered in the field. The first line gives the manufacturer (if known). The second line lists the line size of the component and also any information such as model number, class or type. The last line contains any additional information.
- (5) MATERIAL: Material the component is made of or is assumed to be made of.
- (6) INSTALLATION: Component's installation date.
- (7) INSPECTION: Inservice inspection date.
- (8) RATED PRESSURE: Maximum allowable working pressure (APRES) of the component. This number is arrived at by: information found on the component; information found in the manufacturer's catalog; comparing the components dimensions to dimensions given in the applicable code or standard; by making contact with the manufacturer by phone or by letter; or by using the pipe pressure formula from ANSI B31.
- (9) WORKING PRESSURE: Working pressure (WPRES) of the system at the component's location.
- (10) CODE: Code or standard that the component is designed to. These codes are abbreviated. The abbreviations are explained on the Definition of Symbols page. Entries in the CODE column come from the Manufacturer's catalogs, crossing the component's dimensions with dimensions listed in the code, or by contacting the manufacturer. ASMD in this column means assumed.
- (11) ANALYSIS: Method of analyzing or evaluating the component. Abbreviations are explained on the Definition of Symbols page.
- (12) NDE: Method of non-destructive examination used to evaluate the component. Abbreviations are explained on the Definition of Symbols page.
- (13) FOOTNOTES: Footnotes which further explain or clarify the information for the component. Footnotes are by system and can be found on the Footnotes page.
- (14) REFERENCE: NASA specifications, NASA drawings, TAI Engineering Analysis, and TAI Non-Destructive Examination. These can be referenced on the Recertification Document Reference List.
- (15) REC: Recommendation for each component. The component is either recertified or recommended for removal, repair, derating, or waived.

Figure 2-2, Key To Recertification Status Sheets (Component Inventory).

FACILITY: BLDG. 1247E, WAA
 SYSTEM: 6000 PSI AIR
 REFERENCE SKETCH: 60-A-1

SAMPLE

01-6000A-PSCM
 APR 1, 1997

NO.	Component	END	Manufacturer/Description	Material	Installation	Inspection	Rated Pressure	Working Pressure	Code	Analysis	NDE	Foot Notes	Reference	Rec
1	PIPE ELL	SW	VOGT 2", 6000 CWP	STEEL	12/64	12/92	6000	6000	B11	MC	V	3	D1,D4,E3,S1	RC
2	PIPE ELL	SW	BONNY FORGE 2', 6000#	A105	12/64	12/92	6599	6000	B11	MC	V	62	D1,D4,E3,S1	RC
3	PRE FILTER	BW	DOLLINGER 2', S/N 30781 6500 PSI, "U" STAMP	STEEL	06/76	12/92	6500	6000	81	ES	V		D1,D4,E3	RC
4	BUSHING	TH	UNKNOWN 1/2 X 1/4"	STEEL	06/76	12/92	12250	6000	B11	CE/PS	V	3	D1	RC
4A	MALE ELL	TH	CRAWFORD 1/4", 1/8" SS TUBE	STAINLESS	06/76	12/92	9352	6000	N/A	MC/TC	V	40	D1	RC
5	MALE CONNECTOR	TH	UNKNOWN 1/4", 1/8" SS TUBE	STAINLESS	06/76	12/92	6500	6000	SA5	CE	V	8	D1	RC
6	DIFFERENTIAL PRESSURE GAUGE	TH	ORANGE RESEARCH, INC. 1/4", M/N 1202 PG-1-2 0-100 PSID RANGE	STEEL	06/76	12/92	9352	6000	N/A	TC	V	58	D1	RC
7	MALE CONNECTOR	TH	UNKNOWN 1/4", 1/8" SS TUBE	STAINLESS	06/76	12/92	9352	6000	SA5	CE	V	8	D1	RC
8	BUSHING	TH	UNKNOWN 1/2 X 1/4"	STEEL	06/76	12/92	12250	6000	B11	CE/PS	V	3	D1	RC
8A	MALE ELL	TH	CRAWFORD 1/4", 1/8" SS TUBE	STAINLESS	06/76	12/92	9352	6000	N/A	MC/TC	V	40	D1	RC
8T	TUBE		UNKNOWN 1/8", T=.028"	STAINLESS	06/76	12/92	7482	6000	B3	PS	UT	4	D1,E2	RC
9	COUPLING	SW	BONNY FORGE 3/4', 6000#	A105	06/76	12/92	8466	6000	B11	MC/PS	V		D1,D4	RC
10	PIPE ELL	SW	BONNY FORGE 3/4', 6000#	A105	06/76	12/92	8466	6000	B11	MC/PS	V		D1,D4	RC

Figure 2-3, Recertification Status Sheet (Example).

2.4.3. Field Survey

The R&CM COTR shall ensure that the R&CM Contractor performs field surveys as outlined below. The purpose of the field survey is to identify components within a given system. Experience has indicated that for older systems at LaRC there is rarely any documentation on components. Consequently, detailed field surveys shall be accomplished to assemble data on pressure vessel and system configurations, pipe sizes and schedule, flange, and valve pound-class ratings, manufacturers' pressure ratings, and the location of all welds and support structures. During the field survey, each system shall be visually inspected and any cracks, corrosion, leakage, wear, vibration, missing fasteners, broken supports or welds with surface defects shall be noted.

The information gathered during the field surveys shall be assembled into the pressure system database. Specific information that comprises the pressure system database shall be illustrated on recertification status sheets (Component Inventory). Figure 2-2 details the key to recertification status sheets (Component Inventory) and Figure 2-3 is a sample of a compiled recertification sheet. In addition to gathering documentation regarding a specific pressure vessel or system, an isometric drawing of the pressure system shall be generated using a computer-aided drawing (CAD) package. This drawing shall later become part of the PSD, which shall be a configuration controlled document (CCD).

Frequently, required information for a particular component is not available. When this problem is encountered, the PSM shall provide guidance to the R&CM Contractor to determine a solution. Table 2.2 provides typical problems with possible solutions.

2.4.4. Evaluation of Pressure Vessel or System

After the initial field surveys are conducted and components have been identified, all items shall be analyzed to determine if they are adequate for the system working pressure. This analysis shall be performed as directed by the PSM and shall use the criteria noted in sections 2.4.5, 2.4.6, and 2.4.7 with regards to nondestructive examination, pressure vessel analysis, and piping analysis. Typically, the PSM directs the R&CM Contractor to perform this assessment and denote recommendations on the recertification sheet. However, the PSM may use other assets within LaRC to perform the engineering assessment.

If the analysis indicates that all components are adequate for the system working pressure, the analysis portion of recertification is complete. However, if components are identified that are not considered adequate for the working pressure, they shall be replaced, the system operation pressure shall be reduced to an acceptable level (i.e., derated), or additional analysis/NDE shall be performed. The decision to replace, repair, perform additional NDE, derate, decertify or certify shall be made by the PSM.

A letter shall be sent by the PSM to the Facility Coordinator (FC) and the Facility Safety

Head (FSH) indicating the new limits, with regards to the pressure vessel or system. Also, the engineering assessment report shall become part of the permanent record file for the specific system. It shall be referenced within the PSD on the document reference sheet (see Figure 2-4).

Table 2-2, Typical Data Problem With Possible Solutions.

Problem	Solution														
Unknown material properties	Whenever feasible, sections of these materials shall be removed and both hardness and x-ray fluorescence tests conducted. These tests generally yield good indications of the tensile strength and chemical properties of the materials.														
Unknown material properties and it is not feasible to remove a section of material	<p>The material shall be assumed to be fabricated of the lowest strength material available in the applicable Code. The following presents the materials assumed for various applications.</p> <table> <tr> <th><u>Application</u></th><th><u>Material Assumed</u></th></tr> <tr> <td>Carbon steel pipe</td><td>ASTM A53 Gr. A</td></tr> <tr> <td>Carbon steel fittings</td><td>ASTM A234 Gr. WPA</td></tr> <tr> <td>Carbon steel forgings</td><td>ASTM A181 Gr. I</td></tr> <tr> <td>Stainless steel pipe</td><td>ASTM A312 Gr. TP304</td></tr> <tr> <td>Stainless steel fittings</td><td>ASTM A182 Gr. 304</td></tr> <tr> <td>Stainless steel forgings</td><td>ASTM A182 Gr. F304</td></tr> </table> <p>The charpy impact energies for the above materials shall be obtained from the technical literature. System operating temperatures shall be modified, if necessary, to ensure that these materials have the impact energies required by the Codes.</p>	<u>Application</u>	<u>Material Assumed</u>	Carbon steel pipe	ASTM A53 Gr. A	Carbon steel fittings	ASTM A234 Gr. WPA	Carbon steel forgings	ASTM A181 Gr. I	Stainless steel pipe	ASTM A312 Gr. TP304	Stainless steel fittings	ASTM A182 Gr. 304	Stainless steel forgings	ASTM A182 Gr. F304
<u>Application</u>	<u>Material Assumed</u>														
Carbon steel pipe	ASTM A53 Gr. A														
Carbon steel fittings	ASTM A234 Gr. WPA														
Carbon steel forgings	ASTM A181 Gr. I														
Stainless steel pipe	ASTM A312 Gr. TP304														
Stainless steel fittings	ASTM A182 Gr. 304														
Stainless steel forgings	ASTM A182 Gr. F304														
Flanges that cannot be reasonably analyzed using the criteria of Section VIII Division 1 of ASME Boiler and Pressure Vessel (B&PV) Code.	In one case, 616 identical flanges were found. The maximum allowable working pressure for these flanges was established by proof testing one flange according to the procedures outlined in Paragraph UG-101, "Proof Tests to Establish Maximum Allowable Working Pressure," of Section VIII Division 1 ASME B&PV Code.														
Component made of known, but not Code-approved materials	For these components, the "Basis for Establishing Stress Values" section of the appropriate Code shall be used to determine allowable stresses.														

DOCUMENT REFERENCE SHEET

FACILITY: SML. BLDG 1148
 SYSTEM: 500 PSI NITROGEN

DATE: April 17, 1996

Page 1

REF #	TYPE OF DOCUMENT	IDENTIFICATION NO	TITLE	LOCATION
A 1	T. A. I. ANALYSIS	500	500 PSI NITROGEN ANALYSIS (RECERT)	PSCM CONT. FILES
C 1	CNS	23-37	UPDATE TO REFLECT MINOR CHANGES AS A RESULT OF VISUAL EXAMINATION	PSCM CONT. FILES
D 1	T. A. I. SKETCHES	SK. S - N - 1 THRU SK. 5 - N - 3	500 PSI NITROGEN SYSTEM	PSCM CONT. FILES
D 2	NASA DRAWING	LC - 709889	B - 1148 VACUUM/PRESSURE CHAMBER MODIFICATIONS	EDF
E 1	T. A. I. NDE		NON - DESTRUCTIVE EXAMINATION (RECERT)	PSCM CONT. FILES
S 1	NASA SPECIFICATION	NASI - 18493 SPEC.	S / M FOR CONSTRUCTION OF CARBON-CARBON LABORATORY ADDITION TO BUILDING 1205	CONTRACT FILES

Figure 2-4, Document Reference Sheet.

2.4.5. Nondestructive Examination

Several NDE techniques can be used to assess the material conditions. The required NDE shall be based on whether the system contains high-pressure gas or liquid as outlined below.

Nondestructive examination of high-pressure gaseous systems shall consist of three levels of examination:

1. Visual inspection of the entire system to look for signs of cracks, corrosion, wear, leakage, vibration, missing fasteners, broken supports, or welds with surface cracks, etc.
2. Eddy current, dye penetrant or magnetic particle inspection (depending upon the application) of the high stressed areas identified in the system analysis.
3. Radiographic inspection of ten percent of all welds. (Note, welds on Code stamped pressure vessels shall not be radiographed since a National Board of Boiler and Pressure Vessel Inspectors inspector has already accepted the inspection of the vessels). If unacceptable welds are found during the radiographic inspection, one hundred percent of all welds shall be radiographed.

Nondestructive examination of high-pressure liquid systems shall consist of two levels of examination:

1. Visual inspection of the entire system to look for signs of corrosion, wear, leakage, support deterioration, etc.
2. Eddy current, dye penetrant or magnetic particle inspection (depending upon the application) of the high-stressed areas shall be identified in the system analysis. Welds in liquid systems shall not normally be radiographed since they contain significantly less potential energy than gaseous systems.

NDE performed on existing pressure systems shall be done in accordance with the guidelines provided in Tables 2-1a, b, c, d, and e for Code-Stamped Vessels; Non-

Code-Stamped Vessels, Section VIII, Division 1 Analysis; Non-Code-Stamped Vessels, Section VIII, Division 2 Analysis; All piping except insulated steam piping; and Insulated steam piping, respectively.

2.4.6. Pressure Vessel Analysis

Under the LaRC RECERT program, pressure vessels shall fall into two general categories:

1. Vessels carrying the ASME Boiler and Pressure Vessel Code Stamp or
2. Vessels which do not carry the ASME Code Stamp.

The procedures for evaluating both categories of vessels shall be:

- **Code-Stamped Vessels:** Code stamping of a vessel by a manufacturer shall certify that the vessel has been designed and fabricated in accordance with a section of the ASME Boiler and Pressure Vessel Code (ASME B&PV Code). No additional analysis shall be performed in recertifying Code-stamped vessels. However, these vessels shall be visually inspected as required as part of the inservice inspection program.
- **Non-Code-Stamped Vessels:** These vessels shall be analyzed using the criteria of the current issue of either Section VIII, Division 1 or Section VIII, Division 2 of the ASME B&PV Code. Use of these criteria shall not qualify the vessels for Code stamping. However, these criteria shall provide a rationale for evaluating the integrity of the vessels.

A brief description of the Section VIII, Division 1 and 2 follows:

- **Section VIII, Division 1** (referred to as Division 1): Welded and riveted vessels shall be initially analyzed using the criteria of Division 1. This Division requires continuum analyses of the vessels and that numerous design rules be followed. Depending upon the materials and joint efficiencies used, Division 1 requires a range of 0 percent to 100 percent radiographic inspection of structurally significant welds. Division 1 has stringent requirements on vessel configuration, for example the slopes at head-to-cylinder and cone-to-cylinder junctions and the radii on the outside-corners of nozzles.
- **Section VIII, Division 2** (referred to as Division 2): In some instances, welded vessels satisfy the requirements of Division 1 only when their maximum allowable working pressures are reduced below NASA's operational requirements. In these instances, the vessels shall be analyzed using Division 2. This Division permits higher allowable stresses, and consequently higher pressures, in a given vessel. However, Division 2 requires detailed stress, thermal and fatigue analyses of the vessels. It is more restrictive on configurations and materials than Division 1 and more expensive and time-consuming than Division 1. Furthermore, Division 2 generally requires 100 percent radiographic inspection of structurally significant welds.

Table 2-3a, Nondestructive Examination Performed During System Recertification: Existing Code-Stamped Vessels.

Nondestructive Examination	Inspection Procedure	Acceptance Criteria
High stressed areas and fillet welds are surface inspected using visual, magnetic particle, dye penetrant and/or eddy current techniques.	Visual (Per NDE VT-10A,"Visual Inspection of Pressure Systems, Nondestructive Evaluation Section Procedure).	Evaluate per NDE VT-10A,"Visual Inspection of Pressure Systems, Nondestructive Evaluation Section Procedure.
	Magnetic Particle (Per ASME Boiler and Pressure Code, Nondestructive Examination, Section V).	Evaluate per Rules for Construction of Pressure Vessels, Section VIII, Division 1, ASME Boiler and Pressure Vessel Code, current document.
	Dye penetrant (Per ASME Boiler and Pressure Code, Nondestructive Examination, Section V).	Evaluate per Rules for Construction of Pressure Vessels, Section VIII, Division 1, ASME Boiler and Pressure Vessel Code.

Table 2-3b, Nondestructive Examination Performed During System Recertification: Existing Non-Code-Stamped Vessels, Section VIII, Division 1 Analysis.

Nondestructive Examination	Inspection Procedure	Acceptance Criteria
Same as Code-Stamped Vessels, plus a minimum of 10% of all structurally significant welds are radiographed. A higher percentage may be radiographed if high joint efficiencies are required.	Visual (Per NDE VT-10A,"Visual Inspection of Pressure Systems, Nondestructive Evaluation Section Procedure).	Evaluate per NDE VT-10A,"Visual Inspection of Pressure Systems, Nondestructive Evaluation Section Procedure.
	Magnetic particle (Per ASME Boiler and Pressure Code, Nondestructive Examination, Section V).	Evaluate per Rules for Construction of Pressure Vessels, Section VIII, Division 1, ASME Boiler and Pressure Vessel Code, current document.
	Dye penetrant (Per ASME Boiler and Pressure Code, Nondestructive Examination, Section V).	Evaluate per Rules for Construction of Pressure Vessels, Section VIII, Division 1, ASME Boiler and Pressure Vessel Code, current document.
	Radiography (Per ASME Boiler and Pressure Code, Nondestructive Examination, Section V).	Evaluate per Rules for Construction of Pressure Vessels, Section VIII, Division 1, ASME Boiler and Pressure Vessel Code, current document.

Table 2-3c, Nondestructive Examination Performed During System Recertification: Existing Non-Code-Stamped Vessels, Section VIII, Division 2 Analysis.

Nondestructive Examination	Inspection Procedure	Acceptance Criteria
Same as Code-Stamped Vessels plus 100% of all structurally significant welds are radiographed.	Visual (Per NDE VT-10A,"Visual Inspection of Pressure Systems, Nondestructive Evaluation Section Procedure).	Evaluate per NDE VT-10A,"Visual Inspection of Pressure Systems, Nondestructive Evaluation Section Procedure.
	Magnetic particle (Per ASME Boiler and Pressure Code, Nondestructive Examination, Section V).	Evaluate per Rules for Construction of Pressure Vessels, Section VIII, Division 2 - Alternative Rules, ASME Boiler and Pressure Vessel Code, current document.
	Dye penetrant (Per ASME Boiler and Pressure Code, Nondestructive Examination, Section V).	Evaluate per Rules for Construction of Pressure Vessels, Section VIII, Division 2 - Alternative Rules, ASME Boiler and Pressure Vessel Code, current document.

Table 2-3d, Nondestructive Examination Performed During System Recertification: All Existing Piping Except Insulated Steam Piping.

Nondestructive Examination	Inspection Procedure	Acceptance Criteria
High stress areas and fillet welds are surface inspected using visual, magnetic particle, dye penetrant and/or eddy current techniques. Ten percent of all branch connection, girth, miter, groove and socket welds are radiographically inspected.	Visual (Per NDE VT-10A,"Visual Inspection of Pressure Systems, Nondestructive Evaluation Section Procedure).	Evaluate per NDE VT-10A,"Visual Inspection of Pressure Systems, Nondestructive Evaluation Section Procedure.
	Magnetic particle (Per ASME Boiler and Pressure Code, Nondestructive Examination, Section V).	Evaluate per Rules for Construction of Pressure Vessels, Section VIII, Division 1, ASME Boiler and Pressure Vessel Code, current document.
	Dye penetrant Per ASME Boiler and Pressure Code, Nondestructive Examination, Section V).	Evaluate per Rules for Construction of Pressure Vessels, Section VIII, Division 1, ASME Boiler and Pressure Vessel Code, current document.
	Radiography for girth and miter groove welds (Per ASME Boiler and Pressure Code, Nondestructive Examination, Section V).	Evaluate per ASME Code for Pressure Piping (B31series). Severe cyclic conditions.
	Radiography for socket and branch connection welds LAPG 1710.41, "LaRC Standard for the Evaluation of Socket and Branch connection Welds."	Evaluate per LAPG 1710.41, "LaRC Standard for the Evaluation of Socket and Branch Connection Welds."

TABLE 2-3e, Nondestructive Examination Performed During System Recertification: Existing Insulated Steam Piping.

Nondestructive Examination	Inspection Procedure	Acceptance Criteria
Ten percent of all branch connection, girth, miter groove and socket welds are radiographically inspected	Radiography for all welds (Per Minutes of Meeting, NASA LaRC Pressure Systems Committee, May 9, 1988 and Gianettino, D.P., Slomp, G.E., Berry, R.F., Jr., and Hudson, C.M.: "Radiographic Inspection through Asbestos Insulation," Forty-Sixth Meeting of the Mechanical Failure Prevention Group, Vibration Institute, April 9, 1992.	For girth and miter groove welds, evaluate per ASME Code for Pressure Piping (B31 series) For socket and branch connection welds, evaluate per LAPG 1710.41, "LaRC Standard for the Evaluation of Socket and ranch Connection Welds."

2.4.7. Piping Analysis

All piping components, except steam piping components, shall be analyzed using the criteria of the current issue of the Process Piping Code (ANSI/ASME B31.3). This Code applies to piping that handles liquids and gases and requires a detailed analysis of the piping.

All steam piping components shall be analyzed using the criteria of the current issue of the Power Piping Code (ANSI/ASME B31.1). This Code specifically addresses the design of steam systems. It gives the general design requirements for the design of components and assemblies, including their pipe supports.

2.5. RECERT PHASE 2

The primary objectives of phase 2 are:

1. Repair/replace any defective components found during phase 1,
2. Prepare an Inservice Inspection Plan (IIP), and
3. Complete/develop the permanent record file.

This section details how these three objectives shall be accomplished at LaRC.

2.5.1. New Systems

For a new system, repair/replace defective components is not required. Phase 2 for new systems shall consist of using the data/documentation provided by the PM to prepare the permanent record file and the IIP if not submitted by the PM. The R&CM COTR shall ensure this is performed by the R&CM Contractor. The PSM and PM shall provide guidance to the R&CM Contractor to obtain/develop any missing documentation.

2.5.2. Existing Systems

For each existing system being recertified, the following actions shall be conducted

during phase 2:

- If numerous unacceptable welds were identified in the PHASE 1 radiography, one hundred percent of all welds shall be radiographed.
- All of the unacceptable welds shall be repaired and all of the components that are not rated for the system working pressure, or higher, shall be replaced.
- The R&CM COTR shall ensure the R&CM Contractor prepares the IIP, completes the pressure systems document, and completes the permanent record file.

When all components and welds in the system satisfy the requirements of the applicable National Consensus Codes, the PSM shall recertify the system by issuing a recertification letter.

2.5.3. Repair/Replace Defective Components

As authorized and directed by the PSM, defective pressure components shall be repaired and tested. The PSM, via the R&CM COTR, directs the R&CM Contractor to perform emergency repairs. It shall be the responsibility of the PSM, working with the appropriate FC and FSH, to determine if a repair is an emergency. These are repairs that must be performed as soon as possible, taking into account the nature of the deficiency and the need to operate the pressure vessel/system. For non-emergency repairs, the R&CM COTR shall ensure the R&CM Contractor prepares a repair package under the direction of the PSM. It shall be the responsibility of the PSM to obtain repair services for non-emergency repairs using normal LaRC procurement process.

Specific details regarding repairs conducted as a result of RECERT activities shall be included in the permanent record file.

2.5.4. Inservice Inspection Plan/Schedule/Requirements

The purpose of the Inservice Inspection Plan (IIP) is to maintain system integrity. The IIP shall be applicable to all pressure components, including vacuum vessels and any other unique components designated by the PSM. The maximum period between inspections shall be based on fluid, pressure, and size of the pressure vessel or piping. Tables in NPG 1700.6A, "Guide for Inservice Inspection of Ground-Based Pressure Vessels and Systems," shall be used as a guide in producing the inspection schedule. Inspection intervals are permitted to be modified by the PSM based on engineering judgment to monitor known flaws or highly stressed areas.

The R&CM COTR shall ensure the R&CM Contractor develops the IIP. The IIP shall include the type and period of inspection (i.e., the inspection schedule) along with the specific inspection requirements (e.g., procedures, NDE, etc.). When a pressure system is recertified, the applicable IIP shall be attached to the recertification letter sent by the PSM to the facility coordinator.

The IIP shall use NPG 1700.6A, "Guide for Inservice Inspection of Ground-Based Pressure Vessels and Systems," as a guide to determine items to be inspected. The IIP shall always consider the following key items: Vessels, Piping & Components, Expansion Joints, Flexible Hoses, Relief Valves, and Rupture Disks. Additional items such as separators, traps, condensers, and heat exchangers shall be added based on engineering judgment or from guidance obtained from other national codes, standards, or consensus.

The IIP shall consist of two main sections:

- **Inspection Schedule:** This section of the IIP shall denote the type and periodicity for inservice inspections. Again guidance for the type of inspection (e.g. VT, MT, PT) shall be obtained from NPG 1700.6A, "Guide for Inservice Inspection of Ground-Based Pressure Vessels and Systems," engineering judgment, or other national codes, standards, or consensus. Any variation from the NPG 1700.6A must be authorized by the PSM and justification for the variance shall be provided within the permanent record file.
- **Inspection Requirements:** This section of the IIP shall denote the applicable procedure that shall be followed during inspections. Some procedures shall be locally produced, such as VT-10A from the NDES section at LaRC, while others shall be from the ASME Boiler and Pressure Vessel Code, Section V, Nondestructive Examination. Table 2-3a, b, c, d, and e illustrates specific places for appropriate procedures and evaluations.

The IIP shall be sent to the FSH as an attachment to the Recertification letter (see Figure 2-5) at the end of RECERT phase 2.

2.5.5. Documentation for Pressure Vessels/Systems - Permanent Record File

As required by NPG 1700.6A, "Guide for Inservice Inspection of Ground-Based Pressure Vessels and Systems," each pressure system shall have a permanent record file. At LaRC, this permanent record file shall be established coincident with the production of the Pressure Systems Document (PSD). Information that constitutes the permanent record file shall include the items in Table 2.4. The party responsible for obtaining/developing the document is also provided in Table 2.4.

For new systems, the PM shall provide to the R&CM Contractor the data, as outlined in Table 2.4, required to develop the permanent record file. For those cases where the appropriate documentation has not been provided to the R&CM Contractor, the PSM shall work with the PM and/or R&CM Contractor to develop the necessary documentation.

National Aeronautics and
Space Administration

Langley Research Center
Hampton, VA 23681-0001

447

Date

TO: XXX/Facility Safety Head

FROM: 447/Pressure Systems Manager, Systems Engineering Competency

SUBJECT: Recertification of the Air Storage Field Number 3, (50-ABS),
Building No. 1247E

REF: (1) NPG 1700.6, "Guide for In-service Inspection of Ground-Base
Pressure Vessels and Systems", January 18, 1976
(2) LAPG 1710.40, "Safety Regulations Covering Pressurized
Systems"

The Recertification Team, Systems Engineering Competency has completed the Recertification (RECERT) analysis and inspection of the subject system. All components now satisfy the requirements of References 1 and 2.

The pertinent RECERT documentation has been entered into the Pressure Systems Configuration Management system. This documentation shall, with your assistance, be constantly updated.

The future inspection plan for the subject system is given in the enclosed NASA Drawings, LA-741804 and LA-741805.

Based upon the successful completion of the RECERT analysis and inspection, the subject system shall be recertified for continued use.

(SIGNED)

Pressure System Manager (PSM)

Figure 2-5, Recertification Letter (Example).

Table 2.4, Required Documentation in the Permanent Record File.

Item	Description	Responsible Party	
		Existing	New
Pressure Systems Document (PSD).	<p>This document shall be produced for all pressure vessels/systems and shall be a compendium of component information and sketches. The PSD shall be a CCD document and the R&CM COTR shall ensure the R&CM Contractor publishes the document. It shall contain the following two sections:</p> <p>Introduction: This section shall describe the particular pressure vessel/system. The major components shall be identified and brief descriptions of the operation and configuration of the system given. Photographs, sketches, or drawings shall be used. An isometric CAD drawing shall be included which clearly defines the system boundaries.</p> <p>System/Component Inventory: This section shall tabularize information regarding system components and shall include manufacturers data, material composition, installation date, inspection date, MAWP, working pressure at the components location, code or standard for which the component is designed, method of analyzing or evaluating the component, NDE used to evaluate the component, references, and recommendations regarding repairs, further NDE, or certification. These pages shall be produced as recertification status sheets.</p>	R&CM COTR ensures performance by R&CM Contractor	PM
Engineering Assessment and Design Calculations.	These shall be required analyses that are used to make recommendations noted in system/component inventory above and shall include results of calculations, analysis of inspection results, and any special engineering analysis that was performed. This item shall include any supplementary engineering assessments that have been performed as a result of repairs, alterations or as conditions that have occurred during the service life of the system/component. Design calculations for components such as pressure vessels, vacuum vessels, and piping shall include pressure, temperature, vibration and any other applicable loading. They shall specify the applicable code, standard, or other design basis.	R&CM COTR ensures performance by R&CM Contractor	PM
Manufacturers ' Data Reports. ¹	These shall be any data reports produced by the component manufacturer that substantiates the integrity of the pressure vessel/system. For new pressure vessels/systems, the manufacturer's data reports shall be furnished with all components built to the rules of the ASME Boiler and Pressure Vessel Code (e.g., ASME forms U-1, U-1A, U-2, U-2A, U-3, U-4 as applicable).	R&CM COTR ensures performance by R&CM Contractor	PM
Vendor Information. ¹	For components such as pumps, compressors, valves, gages, relief devices, and flexible hoses, the drawings shall be certified outline and cross-sectional drawings showing information such as make, model, materials of construction, and design and operating data. Vendor data sheets shall also be collected and maintained.	R&CM COTR ensures performance by R&CM Contractor	PM

¹ One hundred percent of this data may not be obtainable for existing pressure vessels/systems, but as much historical data as possible shall be gathered.

Table 2.4, Required Documentation in the Permanent Record File (Cont.).

Item	Description	Responsible Party	
		Existing	New
Manufacturers' Drawings. ²	For components such as pressure vessels, vacuum vessels, piping, heat exchanges, separators, and expansion joints, the drawings shall be either the certified shop fabrication drawings or as-built drawings. The drawings shall contain the following: 1. Manufacturer's name and address; 2. Date of manufacture (see vessel nameplate); 3. Dimensions and details of construction; 4. Design and operating conditions, including service fluid, operations temperature, and MAWP; 5. Material thickness (including head and shell); 6. Identification of material, including type of alloy, tensile properties, and impact properties; 7. Efficiency of weld joints; 8. Nondestructive examinations performed (including radiographic, ultrasonic and magnetic particle.); and 9. Type of pressure tests performed (hydrostatic, pneumatic).	R&CM COTR ensures performance by R&CM Contractor	PM
Inspection, Examination, And Test Results.	Inspection, examination, and test results such as hydrostatic, pneumatic, ultrasonic, magnetic particle and radiographic shall be retained. Of particular importance shall be the records of relief valve tests. Radiographic film and weld joint location drawings shall be sent to the R&CM Contractor for stowage and retention.	R&CM COTR ensures performance by R&CM Contractor	PM
NDE Assessment.	This item shall contain any NDE reports that have been conducted on system components.	R&CM COTR ensures performance by R&CM Contractor	PM
Inservice Inspection Schedule	This section shall contain the inservice inspection schedule along with the corresponding inspection results.	R&CM COTR ensures performance by R&CM Contractor	
Weld Joint Map.	This section shall contain welding joint information and an index for the radiography film that the R&CM COTR shall ensure is kept by the R&CM Contractor.	R&CM COTR ensures performance by R&CM Contractor	
Facsimile of Nameplate Data.	This shall be a facsimile of National Board code stamps, which has been imprinted on the component or vessel.	R&CM COTR ensures performance by R&CM Contractor	
Material Certification of Compliance ¹	If required by contract specifications, material certifications shall be furnished by the material manufacturer for the material supplied to certify compliance with specifications. They shall contain information such as material manufacturer, purchaser, material specification, description of material furnished, heat number, chemical and mechanical properties and results of test.	R&CM COTR ensures performance by R&CM Contractor	PM

² One hundred percent of this data may not be obtainable for existing pressure vessels/systems, but as much historical data as possible shall be gathered.

Table 2.4, Required Documentation in the Permanent Record File (Cont.).

Item	Description	Responsible Party	
		Existing	New
Welding Procedures and Procedure Qualifications.	These shall be required by contract specifications and shall be initially reviewed by NASA. Under normal conditions, these records are not required to be maintained as part of the permanent record file. However, if the welding was of a "special" type, the procedures shall be maintained.	R&CM COTR ensures performance by R&CM Contractor	PM
Records of Pre/Post Weld Heat Treatments.	These shall be required by contract specifications.	R&CM COTR ensures performance by R&CM Contractor	PM
Maintenance History.	This shall be retrieved from the Computerized Maintenance Management System (CMMS) maintained by the Systems Engineering Competency.	R&CM COTR ensures performance by R&CM Contractor	n/a
Records of Modifications.	This section shall contain any CoF specifications that have been completed on a particular system.	R&CM COTR ensures performance by R&CM Contractor	n/a
Accident/ Incident Reports.	These reports shall be maintained by OSFA. The R&CM COTR shall direct the R&CM Contractor to review these reports and include in the permanent record file any specific incident that is applicable to pressure systems, components, or vessels.	R&CM COTR ensures performance by R&CM Contractor	n/a
Cyclic Information or Record of Thickness Measurements.	This section shall contain information regarding the pressure vessel/piping designed cyclic data or records of thickness measurements. Also included in this section shall be the expected corrosion rate. This data shall be reviewed at the recertification date and be considered in the determination of the systems future life expectancy.	R&CM COTR ensures performance by R&CM Contractor	PM
Recertification Memo.	A copy of the recertification memorandum completed by the PSM shall also be included in the file.	R&CM COTR ensures performance by R&CM Contractor	n/a
Deviations.	This section shall contain applicable deviations that apply to the particular pressure system or vessel. The PSC must present a deviation for approval to the Executive Safety Board. Once the deviation has been approved, the PSM shall provide a copy of the approved deviation to the R&CM Contractor for inclusion in the permanent record file.	R&CM COTR ensures performance by R&CM Contractor	PM
Miscellaneous.	This section shall contain any particularly noteworthy observations, findings, evaluations, assessments, or reports that pertain to the applicable pressure system or vessel.	R&CM COTR ensures performance by R&CM Contractor	n/a

For existing systems, the R&CM COTR shall ensure the R&CM Contractor gathers and reviews the following items not included in the PSD during the phase 1 engineering assessment:

- Engineering analyses of pressure system, including structural analysis and flexibility analysis, if applicable or required by ASME Code,
- Manufacturer's Data Reports,
- Facility and system description narrative,
- Inservice inspection plan,
- List of drawings for system,
- Material documentation,
- Field measurements,
- Recertification memorandum, and
- Other pertinent engineering data.

These items shall be referenced on the recertification sheet under the columns FN (footnotes) and REFERENCE (see Figure 2-3). The location of specific supporting data shall be noted in the document reference sheet supplied as part of the PSD (see Figure 2-4).

2.6. RECERT PHASE 3 – INSERVICE INSPECTION

Phase 3 is the inservice inspection element of LaRC's pressure vessels/systems safety program, and whether the system is an existing system or a new system, the activities performed are the same. The primary goal of inservice inspection shall be verification of the integrity of a pressure vessel/system or identification of repairs necessary to maintain the integrity. A secondary goal shall be updating the specific pressure systems documentation.

At the start of phase 3, every time the system is modified or whenever inservice inspections are conducted, the R&CM COTR shall ensure the R&CM Contractor incorporates changes to the pressure system documentation (i.e., the database and permanent record file) using the CNS process detailed in LAPG 1740.4, "Facility Systems Safety Analysis and Configuration Management."

2.6.1. Performing Inservice Inspection

The R&CM COTR shall ensure the R&CM Contractor performs the appropriate inspections as required by the IIP and coordinates with the PSM and the Facility Coordinator (FC) to find a convenient time that does not interfere with facility activities to perform required inspections. All nondestructive evaluation personnel shall be qualified in accordance with American Society for Nondestructive Testing (ASNT) SNT-TC-1A, "Recommended Practice for Nondestructive Testing Personnel Qualification and Certification." Specific inspector qualifications shall be denoted within the NDES procedures.

2.6.2. Results of Inservice Inspection/Repairs

Results of the inservice inspection shall be forwarded to the PSM and appropriate FC and Facility Safety Head (FSH). In addition, a copy shall be placed in the permanent record file. The format for the inspection results shall be denoted within the applicable inspection procedure.

The R&CM COTR shall ensure the R&CM Contractor evaluates the results and determines corrective actions, if any, to be taken. The PSM shall review the R&CM Contractor's evaluations and recommended corrective actions. Similar to RECERT phase 2, actions may include further NDE inspections, no additional action necessary, repairs, or if conditions warrant, derating or decertifying of the system or vessel. If as a result of IIP inspections repairs are necessary, they shall be performed in accordance with section 2.5.3. Those deficiencies that are minor in nature, such as illegible pipe marking, lock wires missing and improper color banding on piping, shall be corrected by the FC through the normal maintenance channels.

2.6.3. Updating Pressure System Documents (PSD)

The R&CM COTR shall ensure the R&CM Contractor updates PSDs and forwards this CCD document through the CNS process per the requirements of LAPG 1740.4. Using the results of the inservice inspections, the data in the pressure system database shall be updated or new Recertification Status Sheets shall be produced if none exist. These updated Recertification Status Sheets and the Pressure Systems Documents (PSDs) shall be available to all facilities at LaRC under the Configuration Management On-Line (CMOL) program. Users are permitted to download and print this information.

2.6.4. Periodic Review of Permanent Record File

Per NPG 1700.6A, "Guide for Inservice Inspection of Ground-Based Pressure Vessels and Systems," the recertification period for pressure vessels and piping shall last from ten to twenty years. At the end of the specified period of time, a review of the permanent record file shall be conducted by an OSFA representative and the PSM. The R&CM COTR shall direct the R&CM Contractor to assist with the review. The purpose of this review shall be to provide an opportunity to consider trends that may negatively (shorten) or positively (lengthen) affect the IIP and recertification interval for a particular system. The PSM shall also have representatives from the Systems Engineering Competency (SEC) and the facility involved in this review to allow comments and concerns from field maintenance and facility operations.

Particular items to be examined shall include:

- The permanent record file,
- Past inservice inspection results (paying particular attention to trends),
- Maintenance history file (from zone maintenance section of the SEC),
- Statistical trends denoted by the NDE inspections, operational concerns, and
- Other items as deemed appropriate.

This review shall consider if the already existing IIP needs modification. After the review has been completed, a new recertification letter shall be issued by the PSM along with the revised, if necessary, IIP. A report outlining findings of this review shall be issued by the PSM and given to the R&CM Contractor to become part of the systems permanent record file.

2.7. ANNUAL REPORTS

As required by NPD 8710.5, "NASA Safety Policy for Pressure Vessels and Pressurized Systems," the PSM shall annually prepare and forward a NASA RECERT Status Report to NASA Headquarters. This report shall include any noteworthy lessons learned, failures, problems, and unique solutions regarding pressure systems.

2.8. PRESSURE SYSTEMS DATABASE

The R&CM COTR shall direct the R&CM Contractor to develop the pressure systems database during phase 1 and 2 and shall ensure the R&CM Contractor maintains the database during phase 3. This database shall include all of the pressure system component information collected during field surveys, IIP, and documentation review for recertification. It shall constitute a substantial portion of the data collected to support the Pressure Systems Document (PSD). Specific information that comprises the pressure systems database shall be illustrated on recertification status sheets. Figure 2-2 details the key to recertification status sheets and Figure 2-3 is a sample of a compiled recertification sheet.

These RECERT status sheets shall be accessible to users at LaRC through the Configuration Management On-Line (CMOL) program. Users can download and print this information.

Continue to Next Section